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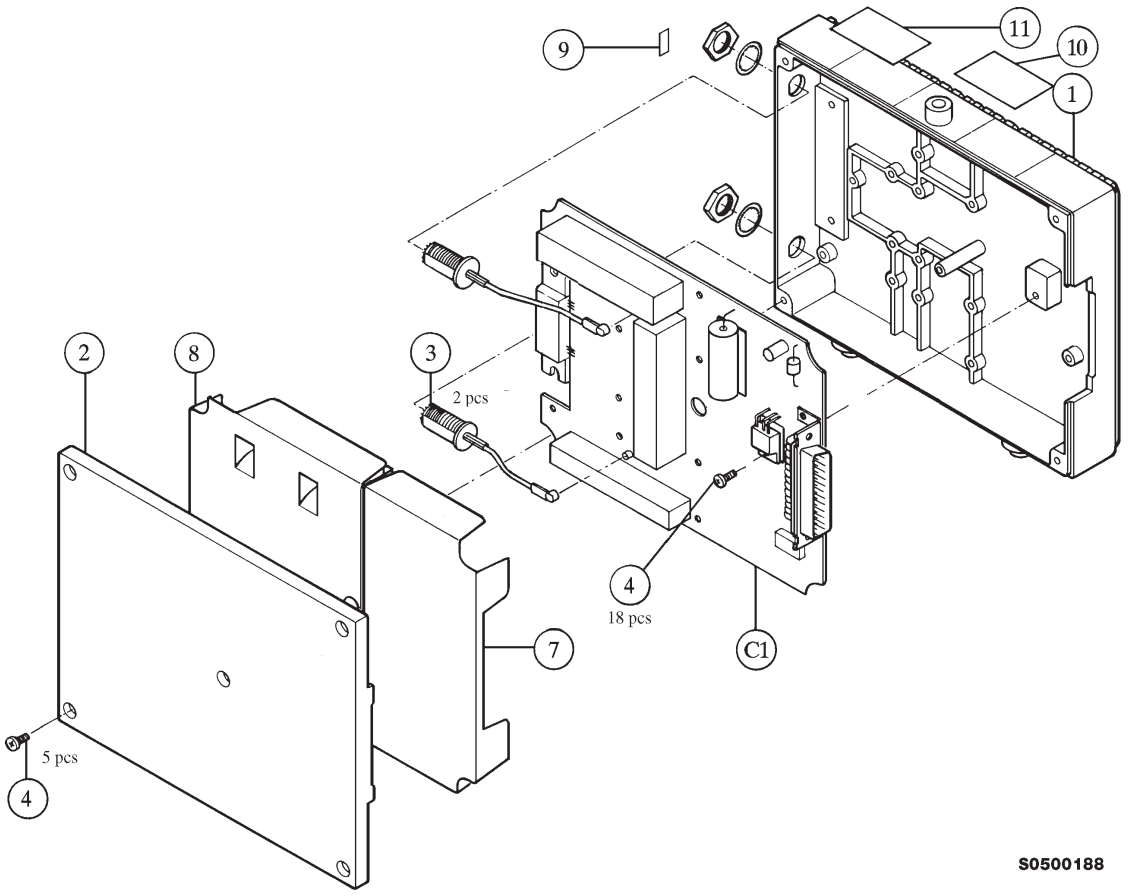
Exploded view



Assembly parts

ITEM	Q'TY	CODE	DESCRIPTION	VALUE, TYPE
1		9537025	Chassis	1D23393 BSH–4
2		9537014	Cover	1D21207 BSH–2
3	2	9780014	Antenna cable	4C21537 NME–1
4	23	6150299	Screw	M3x8 DIN7985
7		9510105	RF shield 1	2D21209
8		9510158	RF shield 2	2D23397
9		9380227	Antenna label	4D22978
10		9380304	Continuous sheet	print. according 4D23551
11		9380304	Continuous sheet	print. according 4D22590
C1		0200271	Booster module DB4	

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V107	4200917	Transistor	BC848B/BCW32	npn 30 V 100 mA SOT23
V108	4202456	MosFet	IRFR9020	p–ch 50 V 8 A TO252
V109	4202456	MosFet	IRFR9020	p–ch 50 V 8 A TO252
V111	4200917	Transistor	BC848B/BCW32	npn 30 V 100 mA SOT23
V112	4200917	Transistor	BC848B/BCW32	npn 30 V 100 mA SOT23
V113	4110130	Zener diode	BZX84	2 % 5.1 V 0.3 W SOT23
V114	4100567	Sch. diode x 2	BAS70–04	70V15 mA SERSOT23
V115	4110130	Zener diode	BZX84	2 % 5.1 V 0.3 W SOT23
V116	4200909	Transistor	BC858B/BCW30	pnp 30 V 100 mA SOT23
V117	4100567	Sch. diode x 2	BAS70–04	70V15 mA SERSOT23
V118	4200917	Transistor	BC848B/BCW32	npn 30 V 100 mA SOT23
V200	4200917	Transistor	BC848B/BCW32	npn 30 V 100 mA SOT23
V201	4210096	Transistor	BCP54	npn 45 V 1.5 A SOT223
V202	4110130	Zener diode	BZX84	2 % 5.1 V 0.3 W SOT23
V203	4110130	Zener diode	BZX84	2 % 5.1 V 0.3 W SOT23
V204	4200917	Transistor	BC848B/BCW32	npn 30 V 100 mA SOT23
V300	4108647	Pin diode	BAR14–1	100 V SOT23
V301	4108647	Pin diode	BAR14–1	100 V SOT23
V302	4210096	Transistor	BCP54	npn 45 V 1.5 A SOT223
V303	4210096	Transistor	BCP54	npn 45 V 1.5 A SOT223
V304	4210096	Transistor	BCP54	npn 45 V 1.5 A SOT223
V305	4110130	Zener diode	BZX84	2 % 5.1 V 0.3 W SOT23
V306	4110117	Zener diode	BZX84	5 % 3.9 V 0.3 W SOT23
V307	4100567	Sch. diode x 2	BAS70–04	70V15 mA SERSOT23
V308	4100567	Sch. diode x 2	BAS70–04	70V15 mA SERSOT23
V400	4200909	Transistor	BC858B/BCW30	pnp 30 V 100 mA SOT23
V401	4210010	Transistor	BFP183	npn 12 V 65 mA 8 GHz
D200	4340024	IC, ROM	MCUH8/534	QFP80A
D201	4342286	IC, EEPROM		8kx8 bit 250 ns SO28W
N100	4346996	IC, regulator	78M05	+5 V TO252AA
N200	4309061	IC, reset generator s	TL7702AID	SO8
N201	434H058	IC, dac 10bit plcc	PM–7533	PLCC20
N202	4345540	IC, 2 x op.amp.	TLC274BID	SO14S
N300	4352222	IC, pow.amp.		6 W TDMA
X200	5432120	D25–conn		angle m metalbracket UNC
X201	5422636	Coax–conn		sfl d=2.5 50 Ω pcb
X202	5422636	Coax–conn		sfl d=2.5 50 Ω pcb
	7313201	Tape pad		1x12x25mm 2–sided wht
	9853961	PC board DB4		117.5x152.0x1.6 d 1/pa

C208	2307816	Ceramic cap.	47 n	20 % 25 V 0805
C209	2604110	Tantalum cap.	10 µ	20 % 25 V 7.3x4.4x2.8
C210	2307816	Ceramic cap.	47 n	20 % 25 V 0805
C211	2310424	Ceramic cap.	100 p	5 % 50 V 0805
C212	2310752	Ceramic cap.	10 n	20 % 50 V 0805
C213	2310350	Ceramic cap.	27 p	5 % 50 V 0805
C300	2310350	Ceramic cap.	27 p	5 % 50 V 0805
C301	2309852	Ceramic cap.	2.7 p	0.25 % 50 V 0805
C302	2309919	Ceramic cap.	8.2 p	0.25 % 50 V 0805
C303	2309852	Ceramic cap.	2.7 p	0.25 % 50 V 0805
C304	2310350	Ceramic cap.	27 p	5 % 50 V 0805
C305	2309852	Ceramic cap.	2.7 p	0.25 % 50 V 0805
C306	2505164	Electrol. cap.	1000 µ	20 % 40 V 12.5x30mm
C307	2307816	Ceramic cap.	47 n	20 % 25 V 0805
C308	2310350	Ceramic cap.	27 p	5 % 50 V 0805
C309	2310350	Ceramic cap.	27 p	5 % 50 V 0805
C310	2310350	Ceramic cap.	27 p	5 % 50 V 0805
C311	2307816	Ceramic cap.	47 n	20 % 25 V 0805
C312	2604093	Tantalum cap.	2.2 µ	20 % 35 V 6.0x3.2x2.8
C313	2604110	Tantalum cap.	10 µ	20 % 25 V 7.3x4.4x2.8
C314	2310350	Ceramic cap.	27 p	5 % 50 V 0805
C315	2310350	Ceramic cap.	27 p	5 % 50 V 0805
C316	2310350	Ceramic cap.	27 p	5 % 50 V 0805
C317	2310350	Ceramic cap.	27 p	5 % 50 V 0805
C318	2310350	Ceramic cap.	27 p	5 % 50 V 0805
C319	2310350	Ceramic cap.	27 p	5 % 50 V 0805
C320	2310544	Ceramic cap.	1.0 n	5 % 50 V 0805
C400	2310544	Ceramic cap.	1.0 n	5 % 50 V 0805
C401	2310544	Ceramic cap.	1.0 n	5 % 50 V 0805
C402	2604110	Tantalum cap.	10 µ	20 % 25 V 7.3x4.4x2.8
C403	2310544	Ceramic cap.	1.0 n	5 % 50 V 0805
C404	2310350	Ceramic cap.	27 p	5 % 50 V 0805
C405	2310350	Ceramic cap.	27 p	5 % 50 V 0805
C406	2309919	Ceramic cap.	8.2 p	0.25 % 50 V 0805
L002	3640301	Chip coil	150 n	20 % Q=30/25 MHz 1210
L100	3606664	Choke	30 µ	
L101	0164030	Choke	9 µ	
B200	4500822	Crystal	11.0592 M	CL30PF h=3.6mm
Z300	4508208	Duplexer		AMPS
Z309	4508372	Hz–6/a25/TX–filt		824–849 MHz AMPS
Z310	4508368	Hz–6/a25/RX–filt		869–894 MHz AMPS
V100	4100218	Trans. supr.	LDP24A	100 V 30A/40 ms AG
V101	4110130	Zener diode	BZX84	2 % 5.1 V 0.3 W SOT23
V102	4200917	Transistor	BC848B/BCW32	npn 30 V 100 mA SOT23
V103	4202456	MosFet	IRFR9020	p–ch 50 V 8 A TO252
V104	4100567	Sch. diode x 2	BAS70–04	70V15 mA SERSOT23
V105	4107027	Zener diode	BZX84	5 % 16 V 0.3 W SOT23
V106	4200917	Transistor	BC848B/BCW32	npn 30 V 100 mA SOT23

R221	1413603	Chip resistor	47 k	5 % 0.063 W 0805
R222	1413635	Chip resistor	100 k	5 % 0.063 W 0805
R223	1412430	Chip resistor	10 k	5 % 0.063 W 0805
R300	1413924	Chip resistor	220	5 % 0.063 W 0805
R301	1413836	Chip resistor	47	5 % 0.063 W 0805
R302	1413924	Chip resistor	220	5 % 0.063 W 0805
R303	1413836	Chip resistor	47	5 % 0.063 W 0805
R304	1413836	Chip resistor	47	5 % 0.063 W 0805
R305	1412335	Chip resistor	1.0 k	5 % 0.063 W 0805
R306	1411669	Chip resistor	22	5 % 0.063 W 0805
R307	1411669	Chip resistor	22	5 % 0.063 W 0805
R308	1411669	Chip resistor	22	5 % 0.063 W 0805
R309	1411669	Chip resistor	22	5 % 0.063 W 0805
R310	1411669	Chip resistor	22	5 % 0.063 W 0805
R311	1411669	Chip resistor	22	5 % 0.063 W 0805
R312	1412335	Chip resistor	1.0 k	5 % 0.063 W 0805
R313	1412409	Chip resistor	1.5 k	5 % 0.063 W 0805
R314	1412409	Chip resistor	1.5 k	5 % 0.063 W 0805
R315	1412423	Chip resistor	4.7 k	5 % 0.063 W 0805
R316	1413635	Chip resistor	100 k	5 % 0.063 W 0805
R317	1412261	Chip resistor	100	5 % 0.063 W 0805
R318	1413635	Chip resistor	100 k	5 % 0.063 W 0805
R400	1412430	Chip resistor	10 k	5 % 0.063 W 0805
R401	1412423	Chip resistor	4.7 k	5 % 0.063 W 0805
R402	1413924	Chip resistor	220	5 % 0.063 W 0805
R403	1412416	Chip resistor	2.2 k	5 % 0.063 W 0805
R404	1413924	Chip resistor	220	5 % 0.063 W 0805
R405	1411669	Chip resistor	22	5 % 0.063 W 0805
R406	1413924	Chip resistor	220	5 % 0.063 W 0805
C100	2307816	Ceramic cap.	47 n	20 % 25 V 0805
C101	2505164	Electrol. cap.	1000 µ	20 % 40 V 12.5x30mm
C102	2307816	Ceramic cap.	47 n	20 % 25 V 0805
C103	2307816	Ceramic cap.	47 n	20 % 25 V 0805
C104	2307816	Ceramic cap.	47 n	20 % 25 V 0805
C105	2307816	Ceramic cap.	47 n	20 % 25 V 0805
C106	2505261	Electrol. cap.	220 µ	20 % 25 V 8.5x11.5
C107	2310544	Ceramic cap.	1.0 n	5 % 50 V 0805
C108	2310424	Ceramic cap.	100 p	5 % 50 V 0805
C109	2310456	Ceramic cap.	180 p	5 % 50 V 0805
C110	2310424	Ceramic cap.	100 p	5 % 50 V 0805
C200	2604110	Tantalum cap.	10 µ	20 % 25 V 7.3x4.4x2.8
C201	2604110	Tantalum cap.	10 µ	20 % 25 V 7.3x4.4x2.8
C202	2307816	Ceramic cap.	47 n	20 % 25 V 0805
C203	2604209	Tantalum cap.	1.0 µ	20 % 16 V 3.2x1.6x1.8
C204	2307816	Ceramic cap.	47 n	20 % 25 V 0805
C205	2604209	Tantalum cap.	1.0 µ	20 % 16 V 3.2x1.6x1.8
C206	2310350	Ceramic cap.	27 p	5 % 50 V 0805
C207	2310350	Ceramic cap.	27 p	5 % 50 V 0805

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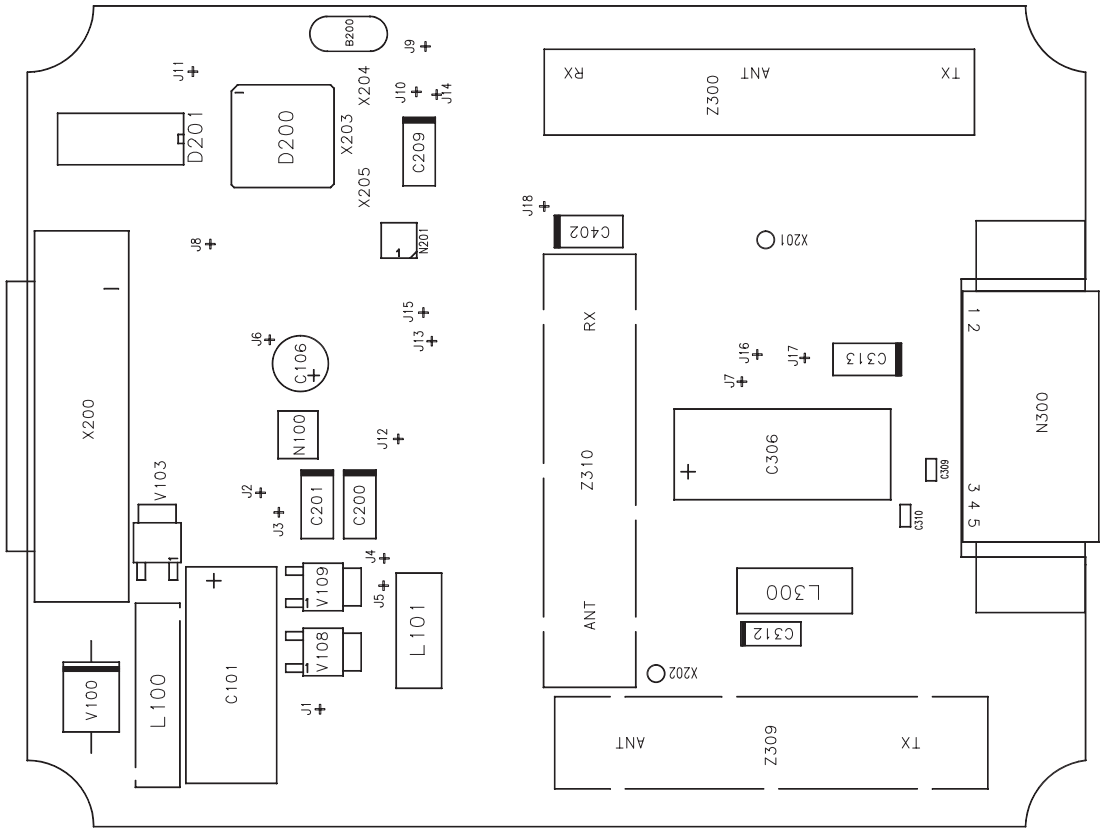
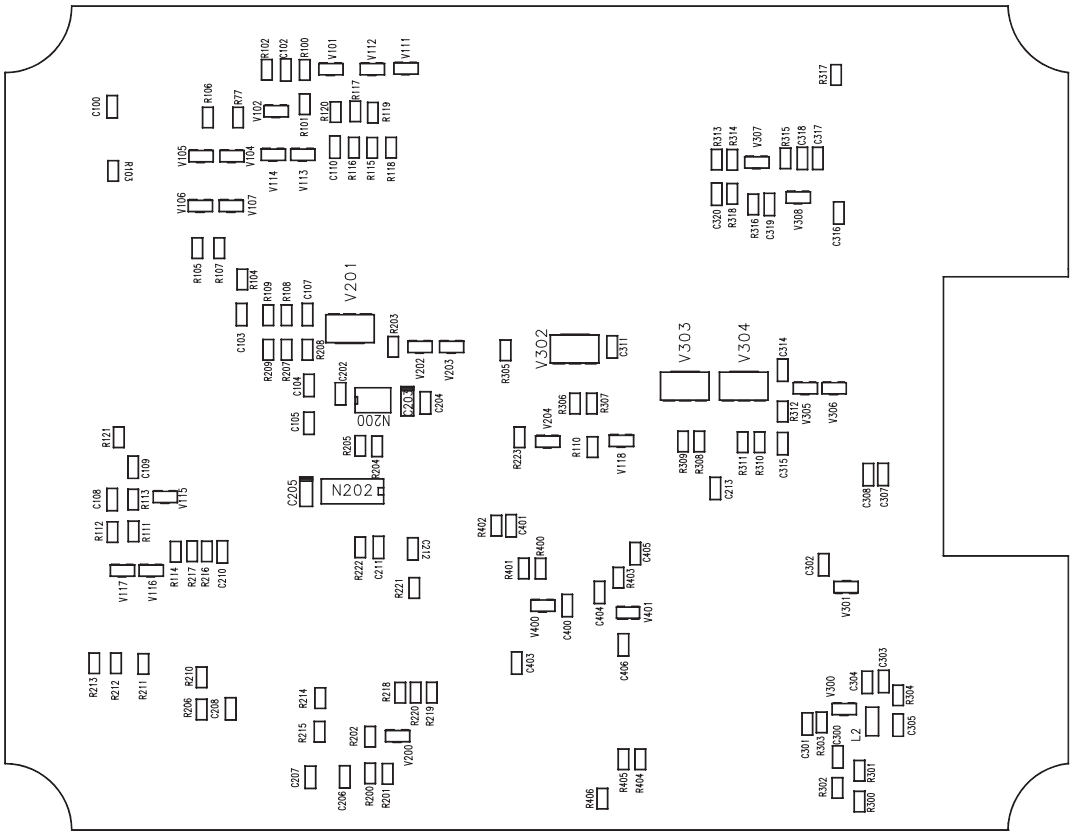
Parts list of DB4

ITEM	CODE	DESCRIPTION	VALUE	TYPE
R077	1412335	Chip resistor	1.0 k	5 % 0.063 W 0805
R100	1412536	Chip resistor	22 k	5 % 0.063 W 0805
R101	1412430	Chip resistor	10 k	5 % 0.063 W 0805
R102	1412536	Chip resistor	22 k	5 % 0.063 W 0805
R103	1412430	Chip resistor	10 k	5 % 0.063 W 0805
R104	1412430	Chip resistor	10 k	5 % 0.063 W 0805
R105	1413635	Chip resistor	100 k	5 % 0.063 W 0805
R106	1412430	Chip resistor	10 k	5 % 0.063 W 0805
R107	1412430	Chip resistor	10 k	5 % 0.063 W 0805
R108	1412423	Chip resistor	4.7 k	5 % 0.063 W 0805
R109	1412536	Chip resistor	22 k	5 % 0.063 W 0805
R110	1412430	Chip resistor	10 k	5 % 0.063 W 0805
R111	1412310	Chip resistor	470	5 % 0.063 W 0805
R112	1412261	Chip resistor	100	5 % 0.063 W 0805
R113	1412409	Chip resistor	1.5 k	5 % 0.063 W 0805
R114	1412430	Chip resistor	10 k	5 % 0.063 W 0805
R115	1412261	Chip resistor	100	5 % 0.063 W 0805
R116	1412261	Chip resistor	100	5 % 0.063 W 0805
R117	1413635	Chip resistor	100 k	5 % 0.063 W 0805
R118	1412335	Chip resistor	1.0 k	5 % 0.063 W 0805
R119	1413635	Chip resistor	100 k	5 % 0.063 W 0805
R120	1413635	Chip resistor	100 k	5 % 0.063 W 0805
R200	1413635	Chip resistor	100 k	5 % 0.063 W 0805
R201	1413603	Chip resistor	47 k	5 % 0.063 W 0805
R202	1413603	Chip resistor	47 k	5 % 0.063 W 0805
R203	1412335	Chip resistor	1.0 k	5 % 0.063 W 0805
R204	1413635	Chip resistor	100 k	5 % 0.063 W 0805
R205	1413635	Chip resistor	100 k	5 % 0.063 W 0805
R206	1413603	Chip resistor	47 k	5 % 0.063 W 0805
R207	1412536	Chip resistor	22 k	5 % 0.063 W 0805
R208	1412430	Chip resistor	10 k	5 % 0.063 W 0805
R209	1412430	Chip resistor	10 k	5 % 0.063 W 0805
R210	1413603	Chip resistor	47 k	5 % 0.063 W 0805
R211	1413603	Chip resistor	47 k	5 % 0.063 W 0805
R212	1413603	Chip resistor	47 k	5 % 0.063 W 0805
R213	1413603	Chip resistor	47 k	5 % 0.063 W 0805
R214	1412423	Chip resistor	4.7 k	5 % 0.063 W 0805
R215	1800673	NTC resistor	15 k	10 % 0.12 W 0805
R216	1412536	Chip resistor	22 k	5 % 0.063 W 0805
R217	1412430	Chip resistor	10 k	5 % 0.063 W 0805
R218	1412536	Chip resistor	22 k	5 % 0.063 W 0805
R219	1412430	Chip resistor	10 k	5 % 0.063 W 0805
R220	1413603	Chip resistor	47 k	5 % 0.063 W 0805

Layout diagrams of DB4





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Circuit diagram of transmitter section

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Circuit diagram of CPU section

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External signals to internal signals

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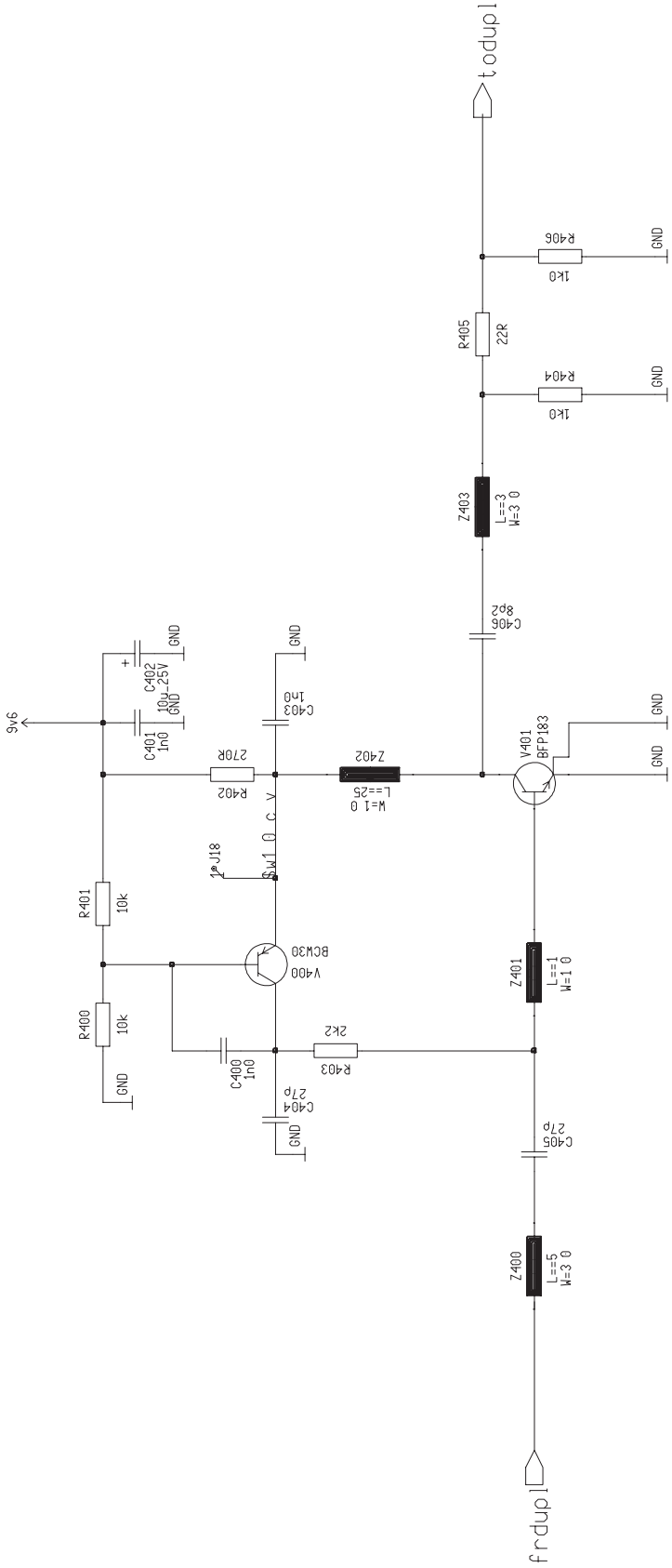
Circuit diagram of receiver section



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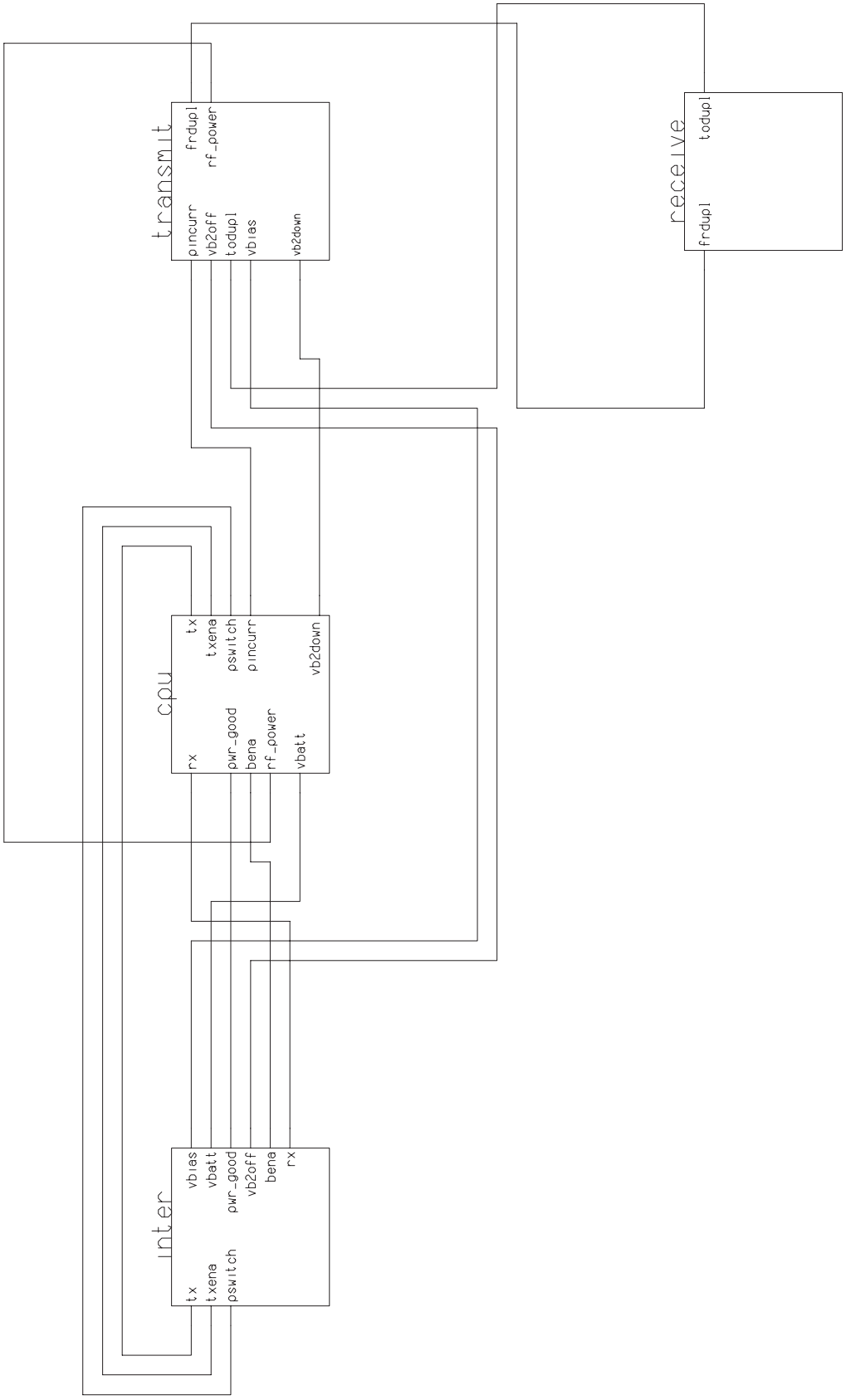
RF and baseband interconnection and external connections



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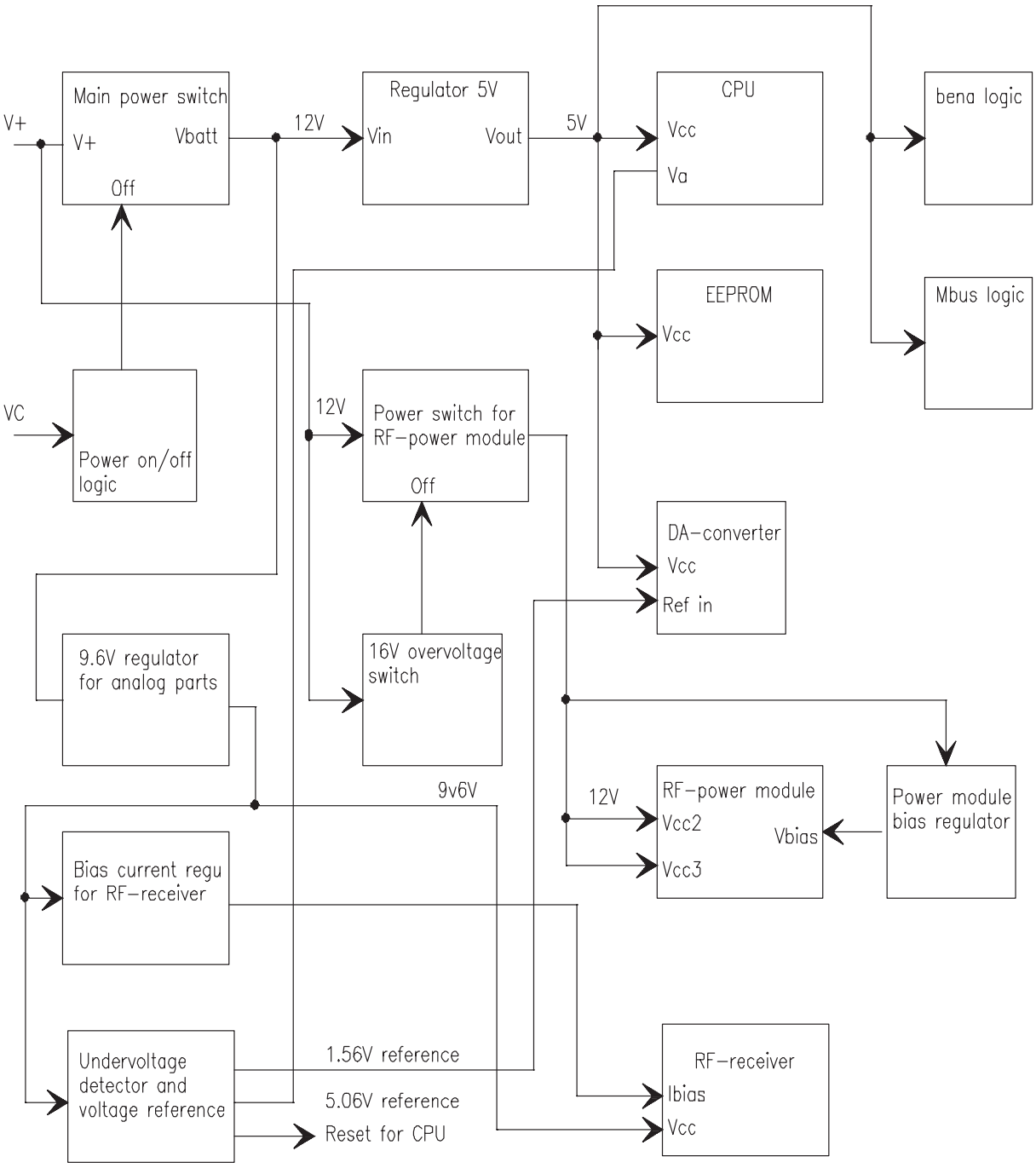
Power Distribution Diagram



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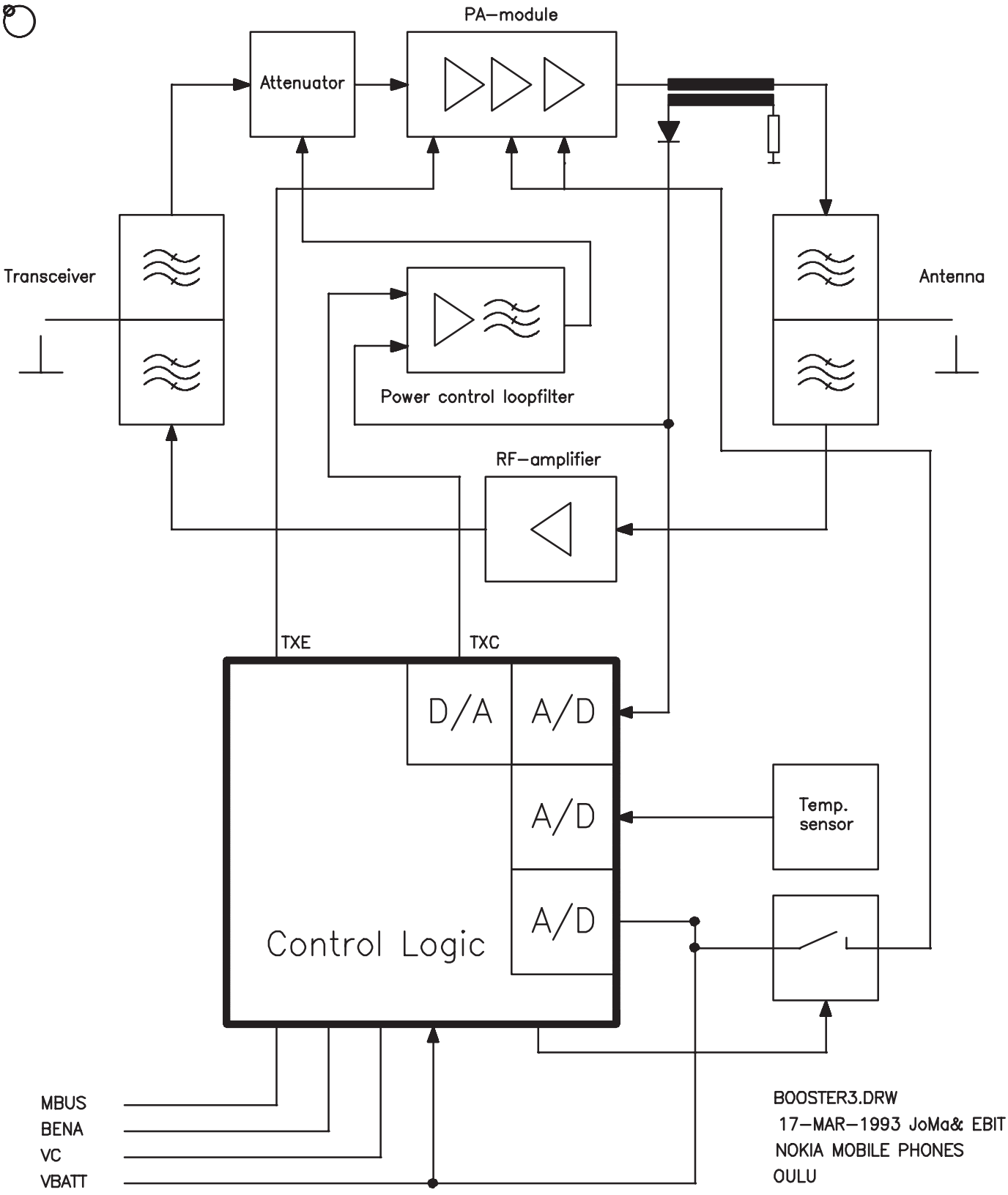
Block Diagram



Control logic

Control logic consists of the MBUS buffer and BENA receiver. MBUS transmitting is buffered via transistors V111 and V112. R119 and R117 are collector resistors, V114 is a protection diode for the situation when the cpu has no power. This diode prevents the pull–down of the MBUS during power down. R115, C110 and R116 are protection components. V113 is used to prevent negative voltages entering to the rx–line and to limit the max voltage to 5.1 V.

BENA is used to control the ramp start and stop. In handportable side there is an open collector transistor used to pull the line down. The current flowing to the line will switch on the transistor V116 via resistor R111. The transistor will conduct and the OBENA line will go up. The switching point is 6mA and the short circuit current is 8 mA, set with the R111 and R112.

Capasitor C108 and zener V115 are used for overvoltage protection. R113, C109 are used to compensate overshoot due to long BENA line. R112 is on current treshold control. V117 avoids reverse leakage current at booster off state.

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If there is any voltage from the detector, the cpu will shut off the mosfets V108 and V109 and so the bias–supply of the PA module. Then it will inform the handportable about the situation.

Power supply logic

Power supply logic has following subparts: power on logic, overvoltage protection, 5 V regulator for logic, 9 V regulator for the analog section, power switch for PA.

The battery voltage V+ comes through connector X200. The transzorb V100 limits the voltage to max. 31 V. L1 is used to limit transient pulses and C100 and C101 will smooth possible variations of the voltage.

Power on logic consists of transistor V102, resistors R100–R102, C102 and zener V101. The VC line from the connector goes from zero to +5 V, when the handportable is connected. The transistor V102 pulls the mosfet V103 gate to ground and V103 conducts. This will turn on the power line VBATT and provide the voltage to other regulators. R103 is used to keep the mosfet off when the V102 does not conduct.

PA module has its own power switch V108 and V109. CPU can control the switch using the control line TXENA. When the TXENA is high, V107 will conduct and turn on V108 and V109. Coil L101 is used to prevent the rf power feedthrough from the PA module.

Supply voltage to PA module should be under 16V. Overvoltage protection for the module is built using zener V105, diode V104, transistor V106 and resistors R77, R106. When the input voltage rises over 16V the zener V105 start to conduct and open the transistor V106 in V107 base. The V107 stops conducting and shuts down V108 and V109. This will cut off the bias power supply from the PA–module during the overvoltage time.

The CPU can control the 8 V bias voltage of the PA module with PSWITCH control line. When the PSWITCH is high the transistor V118 will conduct and pull down the VB2OFF line. This will shut down the the 8 V bias voltage regulators V303 and V304. The bias voltage switch down can be speeded up by switching the V302 on using the VB2DOWN–line.

The CPU can measure the VBATT voltage via A/D converter using resistive divider R108/R109 and C107 and decide if the voltage level has been out of limits for too long time. It this is so the CPU will inform the handportable about the situation. The voltage limits and the timing values are stored in EEPROM.

Logic 5 V is generated by the regulator N100 and C104–C106. The input to the regulator is taken after mosfet V103 and so the logic voltage is cut off when the VC line goes 0. The average current consumption of the logic is 5.4 mA.

The 9.6 V regulator is used to power the analog section of the booster. It consists of the two zeners V202 and V203, transistor V201, resistor R203 and condensators C200–C202.

The total current consumption when the VC line is off is under 100uA.

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EEPROM D201 is connected to ports P5 (data) , P3 ,P1 (address) and P6 (control). Resistors R211–R213 are used to ensure that the control lines are in inactive state during reset.

The CPU has an internal A/D converter wich is used to measure temperature, rf output power and voltage levels.

The reset generator IC TL7702AID and one quarter of the opamp N202 are used to generate 5.06 V reference voltage for the A/D, to NTC resistor R215, and to the D/A converter. The 2.53 V reference voltage from the N200 is amplified to 5.06 V using one quarter of N202 and two resitors R204 and R205. This voltage is fed to the A/D converter reference pin (cpu pin 60). This voltage is also scaled down to 1.58 V with resistors R216, R217 and buffered with one quarter of the N202 for the D/A converter N201.

The CPU uses an D/A converter to set the pin diode current to wanted level. Because only positive voltages were available, the D/A converter N201 is connected to voltage mode. Reference voltage goes to the pin 2 and output is from the pin 19. Because of the operation mode, the reference voltage must not be much over 1.5 V or the linearity suffers. Reference voltage is buffered with one quarter of N202 because the D/A needs a low impedance source.

The D/A converter will output a voltage which is dependent of the digital input word. When the input word is zero the output is zero volts, and when the input is max, the output is at the reference voltage. By changing the input words with CPU the ramp of the output voltage can be controlled. The output voltage is fed via RC filter R222 and C211 to the positive input of one opamp of N202. The time constant of the integrator is 10us and it is used to remove noise from the output voltage of the D/A.

The output power of the PA module is measured with the power detector V308.

Voltage from the power detector is buffered in one amplifier of N202. From there it is fed via resistive divider R218–R220 to the integrator‘s negative input. Divider divides the RF input voltage by 2.66 to scale it to same level as the DA–converter output voltage. Integrator time constant is defined by the capacitor C212 and resistor R221.

Error voltage from the integrator is fed via R223 to the emitter follower V204 and from there to the pindiode attenuator. Emitter follower is used to boost the current drive. C213 is used to attenuate possible rf voltages coming from the pin diode attenuator.

Temperature is measured with NTC resistor R215, resistor R214 and CPU ad–channel 5.

R203 provides biasing for V201. Transistor V201 regulates the voltage with V202 and V203.

If for some reason the PA module has power output without BENA line enabling it, the cpu should switch the RF module off. The power cutoff logic is made with internal A/D converter . One quarter of N202 is continuously monitoring the output voltage of the power detector and feeds it to the A/D converter. When the BENA line is inactive, the cpu reads continuously the power output via A/D.

C309–C312 are RF bypass capasitors for the PA module's power lines. C306 is energy storing capasitor for digital mode switcing transients. C317–C319 are RF bypass capasitors for power detector. C316 prevents detected dc voltage shortcircuit to ground via directional coupler.

Microstriplines and coils:

Z301 and Z302 are PIN diode attenuator matching lines. Z303 is ground return line for the PIN diode current and also resonating with C305. Z304 is 50 ohm interconnection line from the attenuator to the PA module. Z305 is 50 ohm interconnection line from the PA module to the directional coupler. Z306 and Z307 forms the directional coupler. Z308 is 50 ohm interconnection line from the coupler to duplexer Z309. Z311 is connecting duplexer Z310 antenna output to duplexer Z309 and the antenna output pin of X202. L2 is compensating the internal capasitances of the PIN–diodes and thus improving the dynamic range of the attenuator. L101 prevents RF harmonics leaking outside of mechanics.

RF power control logic

RF power control logic consist of H8/534 CPU D200 and several IO–devices. Crystal B200 and capacitors C206 and C207 build an oscillator (11.05692 MHz) for the CPU. IC N200, resistor R206 and capacitor C204 are used to start up the CPU. IC N200 constantly monitors +5 V and +9.6 V signals, and if there are any dropouts it will pull down the reset line and keep it there until the voltages have rised again and after adjustable delay made with C203.

Capasitor C204 is used to prevent the oscillations of the reset line. R206 will pull up the reset line because the TL7702 has an open collector output. Resistor R210 is used to pull up the NMI–line.

Communication with the handportable is done via MBUS. Received MBUS signal is fed through protection circuit to the serial input of the processor pin 67. The MBUS signal is inverted via R201–R202 and V200 for the internal timer input in CPU pin 46. The CPU can use this input to determine when the MBUS has no traffic. Signal is inverted because the timer only reacts to rising edge of the signal and it is better to get the indication right from the startbit.

Transmitted power is controlled by the pindiode attenuator in RF section. The attenuation factor is controlled by the CPU via 10 bit D/A converter N201. It is connected to CPU ports P2 and P4. P4 has the 8 lsb address bits and P2 the upper 2 bits. During operation when the CPU finds rising edge in BENA line it will start delay and after the delay has elapsed will start feeding the D/A with rising values until the needed power level has been achieved.

8k*8bit EEPROM is used to store necessary constants for output levels, attenuation factors and timing factors. The CPU can read and write the EEPROM via its ports. To protect the data, EEPROM is divided to two blocks and both have the same data and checksum. The EEPROM is written only during the calibration.

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Power amplifiers

Transmitted constant level signal from handportable TRX is routed via duplexer Z300 to fixed attenuator pad. Then signal goes through the voltage controlled variable PIN diode attenuator. This stage has about 38 dB control range and it takes care of the power ramping and desired power level setting in both analog and digital modes. After that the signal is fed to power amplifier module, which has 37 dB gain. Its maximum output power is +38 dBm. The module can be switched to isolating state by switching off Vbias in PA modules pin 2. This is done with signal VB2OFF. During rampdown PA bias capasitor C313 is discharged with V304 by signal VB2DOWN. During false transmission or with overvoltage the power supply line for PA module is switched off. After PA module a small portion of output power is picked by the power detector with a directional coupler. Power detector is heavily forward biased to increase linearity. Output voltage from detector is limited by means of shunt diode switch. After the directional coupler the signal is fed to the antenna via output duplexer Z309. A separate 8V regulator for PA module bias voltage maintains performance with varying battery voltages.

Semiconductors:

V301 and V300 are PIN diodes for variable attenuator. V303 and V304 are regulator transistors for power amplifier bias voltage, they can be switched off by setting VB2OFF to 0 V. V302 is discharging switch for C313. It can be activated by setting VB2DOWN to 5V. V305 and V306 provide reference voltage for V303 and V304. V308 is Schottky diode pair for power detector rectifier. V307 is Schottky diode pair for detected voltage limiter.

Resistors:

R300 ...R302 form fixed PI attenuator. R303 and R304 are matching resistors in variable attenuator. R312 gives bias current for V303 and V304 base and for zener diodes V305 and V306. R317 is matching resistor for the directional coupler. R315 is power detector’s voltage divider’s upper resistor. R314 is power detector’s voltage divider’s lower resistor, which comes in action only when detected voltage exceeds 0.6 volts thus opening the diodes in V307. R316 is basic load for power detector. R318 and R313 sets 0.3 volt forward bias for power detector diodes. The same potential is fed to other end of R314 to prevent backward biasing during high power levels. R308–R311 are current limiting resitors for the bias regulator transistors. R306, R307 are collector current limiting resistors for V302. R305 is base current limiter for V302.

Capasitors:

C300 and C304 are DC block capasitors to prevent PIN–diode current to be shorted via coil L2. C301–C304 are PIN–diode attenuator matching capasitors. C305 is resonating with Z303 and thus improving attenuator matching to PA module. C307 and C308 are supply bypass capasitors to PA module 8 V bias voltage. C313 smooths the rising and falling transients during power ramping and thus limits the transmitted spectrum spread. C314 and C315 are RF bypass capasitors for V303 and V304.

Functional Description

Circuit Description

The heart of the control logic is the Hitachi H8/534 microcontroller running 11.0592 MHz. It adjusts the output power accordingly to a given power level and temperature. The controller also monitores TX output power and can switch power off from the power amplifier if any false transmission is detected. Output power is ramped up and down under CPU control, CPU outputs the ramp values to external 10 bit D/A converter.

An external EEPROM is used to store factory tuning values and other data. The data in EEPROM is secured by checksum and double copy.

The CPU also takes care of all the timing functions. When it receives the TX enable signal (BENA), it starts an adjustable delay and then ramps up the TX power to level given by the handportable via MBUS. When the TX enable signal is removed a new adjustable delay is started and at the end of it, TX power is ramped down. Both delays are adjustable and stored in EEPROM. Nominal delay values are 623 µs for ramp up and 123 µs for ramp down.

Receiver

Received signal from antenna connector is routed via RX– duplexer Z310 to low noise linear RF amplifier, which has 14 dB gain and 1.8 dB noise figure. Full gain for booster RX path is specified to ca.7 dB. This way it is possible to maintain transceiver RX sensitivity. The dc power for the amplifier is fed from regulated 9.6 V supply and the amplifier has active biasing to maintain performance during battery voltage variations. After amplification signal is fed to handportabe TRX via pi–attenuator and duplexer Z300.

Semiconductors:

V401 is low noise linear RF amplifier. V400 provides constant current to V401.

Resistors:

R403 feeds base bias for V401. R402 is current sensing resistor for active bias feedback loop. R400 and R401 sets base voltage for V400 and thus collector voltage for V401. R404 –R406 forms pi–attenuator to set module gain to right value.

Capasitors and microstriplines:

C405 is DC blocking capasitor to prevent the base voltage of the V401 to be shorted to ground via duplexfilter. C406 is matching the output impedance of the V401 to 50 ohm input impedance of duplexer. C404, C403 and C401 are RF bypass capasitors. C400 is stabilizing the active bias feedback loop. C402 is filtering the power supply line. Z402 is part of output impedance matching of the V401. It also feeds dc power to the V401. Z400 and Z403 are 50 ohm transmission lines to connect the amplifier to duplexers. Z401 acts as interconnection line between C405 and the base of V401.

RF_IN connector, X201

Pin	Symbol	Description
1	RF_IN	Input to input duplexer • min./typical/max. +10 dBm/+14 dBm/+16 dBm • DC connected to ground via duplexer
2	GND	Ground connection

RF_OUT connector, X202

Pin	Symbol	Description
1	RF_OUT	Output from output duplexer • min./max. +6.8 dBm/+34.8 dBm • DC connected to ground via duplexer
2	GND	Ground connection

Internal Signals and Connections

Internal signal names between RF and logic modules

TXENA	PA module power control signal
PSWITCH	control line to bias switch transistor
TX	Serial bus from CPU
RX	Serial bus to CPU
VBATT	logic and analog main supply.
VBIAS	main supply to PA–module
PWR_GOOD	power supply voltage monitoring line
VB2OFF	PA–module bias switch off signal
OBENA	control signal to CPU timer input capture register.
RF_POWER	output signal from rf–detector
PINCURR	control signal to pin diode attenuator
FRDUPL	input signal from input duplexer to rf input amplifier
TODUPL	output signal from rf amplifier to output duplexer
VB2DOWN	bias voltage pulldown control.

After handportable is put into the cradle it will display booster connected indication for few seconds.

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Technical Specifications

Modes of Operation

The module has two operation modes, analog and digital.

External Signals and Connections

Connector name	Notes	Description
X200	System connector, D25	Control signals from handportable
X201	RF_IN, mini–UHF type	RF signal from handportable
X202	RF_OUT, mini–UHF type	RF signal to antenna

Sytem Connector, X200

Pin	Symbol	Description
3	GND	Battery ground connection • typical/nominal 0 V
4	+V	Battery voltage supply • min./typical/max. +10.0 V/+12.5 V/+16.0 V
6	VC	Main on/off switch voltage • min./max. 0 V/+5 V • >5 V switches booster on
7	BENA	Control signal to switch booster transmitter on/off • min./typical/max. 0 mA/6 mA/8 mA • current controlled, 200 Ω to +3 V, Switch on current 6 mA, max short circuit current 8 mA
12	M2BUS	Communication bus to booster • 100k to +5 V, 200 Ω in series
16	+V	Battery voltage supply • min./typical/max. +10 V/+12.5 V/+16.0 V
17	GND	Battery ground connection • typical 0 V
24	GND	Battery ground connection • typical 0 V

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Basic Specifications

Cellular system	North American Dual–mode
TX frequency band	824.010,...848.970 MHz
RX frequncy band	869.010,...893.970 MHz
Power class	1
Maximum output power	3 W
Power supply voltage	10.5,...16 V
Current consumption, stand by	< 0.1 mA
Current consumption, analog mode trans.	2.5 A (full power)
Current consumption, digital mode trans.	1.5 A (full power)

List of Submodules

The booster does not contain separate submodules. It can be divided into receiver, power amplifier, power control logic and power supply logic.

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Introduction

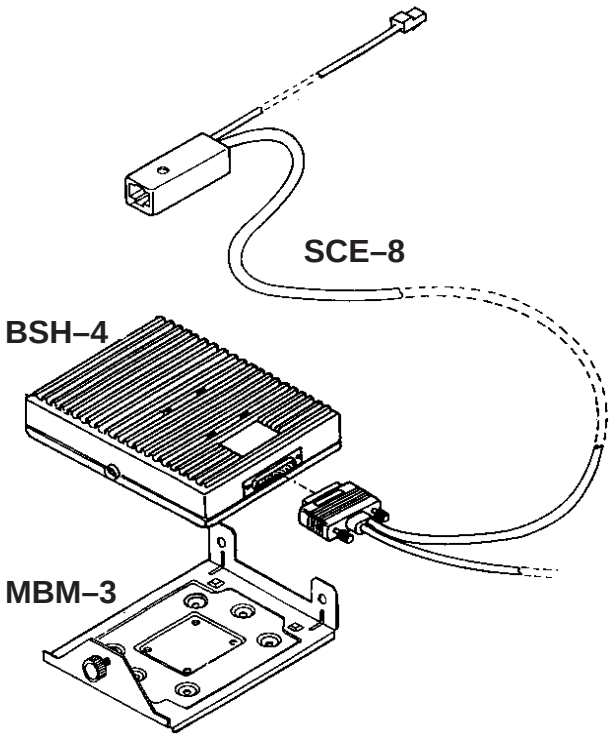
Technical Summary

RF booster is an accessory device to increase handportable tranceiver transmit power. Handportable is a power class IV transceiver. Booster is built for power class I. Modes of operation are analog and digital. Booster contains also a RF preamplifier for handportable receiver.

Necessary control logic is included. Main functions of the logic are: TX power control and compensation. Control logic is conneted to handportable via MBUS and two control lines. TX power ramp–up and ramp–down timing is controlled using control line BENA.

List of Modules and parts of RF booster

Dual mode RF booster BSH–4	0500188
RF booster module DB4	0200271
Assembly parts MBSH–4	0260286
Booster cable SCE–8	9780091
D25 extension cable SCE–9	9780083
RF extension cable XRH–1	9780039
Mounting bracket booster MBM–3	0700016



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